

## PATENT ABSTRACTS OF JAPAN

105

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(71) Applicant : HITACHI LTD

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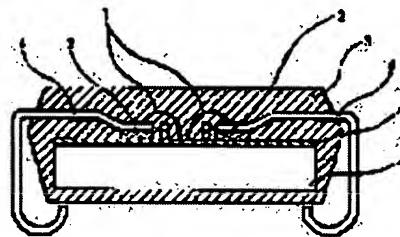
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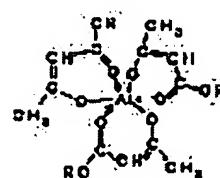
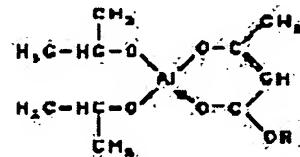
## (54) SEMICONDUCTOR DEVICE

## (57) Abstract:

PURPOSE: To provide a semiconductor device which is sealed with a specific epoxy resin, thus is excellent in adhesion, reflow-soldering resistance, temperature cycle and high-temperature shelf stability.



CONSTITUTION: This semiconductor device is sealed with an epoxy resin composition comprising (A) an epoxy resin such as a bisphenol-A epoxy resin, (B) a curing agent having phenolic hydroxyl groups such as bisphenol A, (C) a curing accelerator such as triphenyl phosphine, and (D) an aluminum-chelating agent of formulas I and II (R is methyl, ethyl, isopropyl- or butyl), preferably in an amount of 0.005-5wt.% (based on component A). This semiconductor device is obtained by surface-treating the semiconductor element in which the electrodes fixed to the inner lead in the lead frame on the semiconductor element surface is electrically connected to the inner lead and a part of lead frame 4 with a silicone-coupling agent solution containing aluminum-chelating agents of formulas I and II, and sealing the semiconductor element and a part of lead frame 4 with the epoxy resin stated above.



Al chelate  $\rightarrow$  ↑ adhesive Cp. 2

AN 1996:379346 CAPLUS  
 DN 125:88682  
 ED Entered STN: 29 Jun 1996  
 TI Solder-reflow crack-resistant semiconductor devices packaged by epoxy resin compositions  
 IN Ishii, Toshiaki; Eguchi, Kunyuki; Mogi, Akira; Kokado, Hiroyoshi  
 PA Hitachi Ltd, Japan  
 SO Jpn. Kokai Tokkyo Koho, 9 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM C08G059-62  
 ICS C08G059-68; H01L023-24  
 CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 76  
 FAN.CNT 1

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 08059795	A2	19960305	JP 1994-198168	19940823 <-
PRAI JP 1994-198168		19940823		

CLASS

PATENT NO.	CLASS	PATENT FAMILY CLASSIFICATION CODES
JP 08059795	ICM	C08G059-62
	ICS	C08G059-68; H01L023-24
	IPCI	C08G0059-62 [ICM,6]; C08G0059-68 [ICS,6]; H01L0023-24 [ICS,6]

GI

\* STRUCTURE DIAGRAM TOO LARGE FOR DISPLAY - AVAILABLE VIA OFFLINE PRINT \*

AB Title devices are packaged by compns. containing epoxy resins, phenolic OH-containing curing agents, curing accelerators, and Al chelates I or II (R = Me, Et, Me<sub>2</sub>CH, Bu). The chelates improve adhesion between Si, the packaging materials, and polyimide passivation membranes. (Thus) 3,3',5,5'-tetramethyl-4,4'-dihydroxybiphenyl diglycidyl ether 85, glycidyl ether III 15, phenol resin IV 54, Ph<sub>3</sub>P 2, silica 1087, Al tris(Et acetoacetate) 0.2 part, etc., were mixed to give a composition, which showed good adhesion to Al and polyimide.  
 ST crack resistance epoxy packaging semiconductor device; crosslinker phenol resin semiconductor packaging; silicon coupler aluminum chelate packaging semiconductor  
 IT Coupling agents  
 (Al chelates; solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing Al chelates)  
 IT Phenolic resins, uses  
 RL: MOA (Modifier or additive use); TEM (Technical or engineered material use); USES (Uses)  
 (crosslinking agents; solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing  
 Al chelates)  
 IT Crosslinking agents  
 Electronic device packaging  
 (solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing Al chelates)  
 IT Phenolic resins  
 RL: POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
 (epoxy, solder-reflow crack-resistant semiconductor devices sealed with

phenol-type compound-cured epoxy resin compns. containing Al chelates)  
IT Epoxy resins  
RL: POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(phenolic, solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing Al chelates)  
IT 100-52-7DP, Benzaldehyde, reaction products with phenol resins, phenols, and epoxy resins 25053-96-7DP, o-Cresol-formaldehyde copolymer, epoxidized, reaction products with glycidyl ethers of aromatic phenols and phenolic resins 30420-31-6DP, Dicyclopentadiene-phenol copolymer, epoxidized, reaction products with glycidyl ethers of aromatic phenols and phenol resins 40039-93-8DP, polymers with phenolic polymers and epoxides 142807-07-6DP, polymers with phenolic polymers and epoxides 177964-71-5P 177964-72-6P 178965-58-7DP, reaction products with epoxy resins  
RL: IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing Al chelates)  
IT 14782-75-3 15306-17-9 59561-04-5 83779-04-8 97494-08-1  
102532-54-7 105054-99-7 177964-73-7  
RL: MOA (Modifier or additive use); TEM (Technical or engineered material use); USES (Uses)  
(solder-reflow crack-resistant semiconductor devices sealed with phenol-type compound-cured epoxy resin compns. containing Al chelates)

DERWENT-ACC-NO: 1996-184875

DERWENT-WEEK: 199619

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TITLE: Semiconductor packaged using epoxy! resin composite  
contg. phenolic setting accelerator and alumino chelate  
deriv. and opt. filler.

PATENT-ASSIGNEE: HITACHI LTD [HITA]

PRIORITY-DATA: 1994JP-0198168 (August 23, 1994)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN IPC
<u>JP 08059795 A</u>	March 5, 1996	N/A	009	C08G 059/26

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP 08059795A	N/A	1994JP0198168	August 23, 1994

INT-CL (IPC): C08G059/62, C08G059/68 , H01L02/24

ABSTRACTED-PUB-NO: JP 08059795A

BASIC-ABSTRACT:

Semiconductor packaged using resin composite contg. epoxy resin, setting agents contg. phenolic hydroxyl gp. setting accelerators, and alumino chelate agents of formula (1) or (2) are new. R=CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>3</sub>H<sub>7</sub> or C<sub>4</sub>H<sub>9</sub>.

Also claimed is semiconductor apparatus contg. semiconductor elements in a lead frame coated by silicon coupling soln. contg. aluminechelate agent of formula (1) or (2), and as packaged using an epoxy resin composite contg. epoxy resin, phenolic hydroxyl-containing setting agents, and setting accelerators.

Also claimed is the semiconductor apparatus packaged by the epoxy resin composites contg. 50-85 wt.pts. of inorganic fillers.

CHOSEN-DRAWING: Dwg.0/4

TITLE-TERMS: SEMICONDUCTOR PACKAGE POLYEPOXIDE RESIN COMPOSITE CONTAIN PHENOLIC SET ACCELERATE ALUMINO CHELATE DERIVATIVE OPTION FILL

DERWENT-CLASS: A21 A85 E11 E12 L03 U11

CPI-CODES: A05-A01E2; A08-D; A08-D01; A08-D05; A12-E04; A12-E07C; E05-B03;  
L04-C20A; L04-C20D; L04-D10;

EPI-CODES: U11-A07; U11-E02A1;

CHEMICAL-CODES:

Chemical Indexing M3 \*01\*  
Fragmentation Code  
A313 A960 C710 H401 H481 J0 J011 J2 J271 J5  
J581 M210 M211 M212 M213 M214 M231 M232 M233 M22  
M272 M281 M282 M311 M321 M342 M382 M391 M411 M510  
M520 M530 M540 M620 M630 M781 M903 M904 Q454  
Markush Compounds  
199619-C0701-U 199619-C0702-U

ENHANCED-POLYMER-INDEXING:

Polymer Index [1.1]

**\* NOTICES \***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

[Industrial Application] This invention relates to the plastic molded type semiconductor device excellent in the solder-proof reflow crack nature closed with the epoxy resin constituent which was excellent in a moldability and the dynamic physical properties after hardening, and was excellent in adhesion with each insertion which carries out a semiconductor device configuration.

**[0002]**

[Description of the Prior Art] Since mass production nature is high, the resin seal technique is widely used as a package technique of semiconductor devices, such as a transistor, and IC, LSI. Generally the constituent which blended the hardening accelerator with an epoxy resin and phenol resin is used for the semi-conductor closure ingredient.

[0003] Since the configuration and the mounting approach of a semiconductor device are changing from the increment in the degree of integration of a semiconductor device, and the demand of a miniaturization of an electronic electrical machinery and apparatus in recent years, still much more high-reliability-ization, such as the thermal resistance of closure resin, moisture resistance, and reduction in stress, is desired.

[0004] For example, in the semiconductor device of a surface mount mold, since the whole package is heated by 200-260 degrees C at the time of mounting to a printed circuit board, if the package has absorbed moisture, expansion of a package, exfoliation of an insertion and a sealing agent, and a package crack will arise by rapid expansion of internal moisture.

[0005] Examination for making small moisture absorption of raising the high temperature strength of the closure resin layer at the time of a reflow from the former and a resin layer is carried out to this problem. In the thin semiconductor device, in order to prevent making moisture absorption smaller than raising the reinforcement of a closure resin layer, and exfoliation, it has been effective technique to heighten the adhesive strength of an insertion and closure resin. The semiconductor device closed as this approach with the epoxy resin constituent which consists of a biphenyl mold epoxy resin and a phenol aralkyl resin curing agent is indicated by the JP,3-207714,A list at JP,4-48759,A. Moreover, in the semiconductor device using the resin constituent which consists of an epoxy resin which has naphthalene structure, it is indicated by the JP,4-50223,A list at JP,4-199857,A. Generally, silane coupling agents, such as an epoxy silane, are blended into the epoxy resin constituent in order to raise the adhesive property of a sealing agent. However, also when an epoxy resin and these coupling agents are combined, the effectiveness over solder-proof reflow nature is not enough.

**[0006]**

[Problem(s) to be Solved by the Invention] Although the Prior art using the epoxy resin system which has low moisture absorption and high adhesive strength is excellent in solder-proof reflow nature, still, the effectiveness is not enough. Moreover, if it takes notice of internal exfoliation of a semiconductor device, it is important to heighten the adhesive strength between the polyimide passivation film used in order to protect the circuit side of a silicon chip or a silicon chip from the stress from a sealing agent,

and a sealing agent. Exfoliation of this part becomes the cause of reducing remarkably the humidity-tolerant reliability after mounting, and temperature cycle nature.

[0007] The object of this invention is to offer the plastic molded type semiconductor device excellent in the solder-proof reflow nature closed with the epoxy resin constituent which has each insertion of a semiconductor device, and a good adhesive property, temperature cycle nature, and humidity-tolerant reliability.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned object, this invention person etc. examined the chemical structure and adhesive strength of a coupling agent as an adhesive improver which are added to various epoxy resins and a curing agent so that he might raise the adhesive strength to the polyimide of the sealing agent after shaping, and the adhesive strength to a metal. Consequently, when using the chelate complex of aluminum, it found out that the adhesive strength of silicon, a sealing agent and the polyimide passivation film, and a sealing agent improved.

[0009] That is, the plastic molded type semiconductor device of this invention is characterized by closing an epoxy resin, and the curing agent and hardening accelerator which have a phenolic hydroxyl group, and the compound further expressed with \*\* 1 or \*\* 2 with the epoxy resin constituent contained as an indispensable component.

[0010] In this invention, as long as an epoxy resin has two or more epoxy resins and is generally used as resin for semi-conductor closure into a monad, it may be what kind of thing. The epoxy resin of two or more organic functions with which such an epoxy resin has a biphenyl frame, a naphthalene frame, and a dicyclopentadiene frame in bisphenol A, F or a smooth S form epoxy resin, a phenol novolak mold epoxy resin, a cresol novolak mold epoxy resin, and a molecule, cycloaliphatic epoxy resin, the epoxy resin which brominated the above epoxy resin are mentioned. independent [ in these ] in this invention -- or it is used, mixing in some numbers.

[0011] In this invention, as long as the curing agent which has a phenolic hydroxyl group has two or more hydroxyl groups of phenol nature and is generally used as resin for semi-conductor closure into a monad, it may be what kind of thing. As such a curing agent, bisphenol A, F or S, a phenol novolak, a cresol novolak and the biphenol that has a biphenyl frame in a molecule, the thing which has a naphthalene frame, the thing which has a dicyclopentadiene frame and the copolymer of the above resin, or some kinds of mixture are used. These are used according to many physical properties, such as moldabilities, such as the reactivity of resin, and a fluidity, and moisture absorption of a hardened material, dynamics physical properties.

[0012] A hardening accelerator is added by it in order to make the epoxy resin constituent used for this invention promote a hardening reaction. The hardening accelerator used by this invention is not limited especially if the hardening reaction of an epoxy resin and a curing agent is promoted. usually, the preservation stability of an epoxy resin constituent, a moldability, the electrical property after hardening, etc. [ good ] Triphenylphosphine, triphenyl FOSUFONIUMU-triphenyl borate, tetra-phenyl FOSUFONIUMU-tetraphenyl borate, And the thing which contains phosphorus in molecules, such as these derivatives, and triethylenediamine, diamino diphenylmethane, In one kind or two or more kinds, it is added by the epoxy resin and the thing of amine systems, such as 1, 8-diazabicyclo (5, 4, 0)-undecene, an imidazole, and its derivative, BF3, sulfonium salt, etc. are used. An addition can be decided to be arbitration in accordance with the moldability of an epoxy resin constituent, or the physical properties of a hardened material.

[0013] An aluminum chelate compound needs of the epoxy molding material in this invention to be blended [ which is expressed with \*\* 1 and \*\* 2 ], and it is desirable to blend 0.005 to 5% of the weight to an epoxy resin. Namely, 0.005 In weight %, when effectiveness is small to the adhesive property of an epoxy molding material, various metals, polyimide, etc. and surpasses 5 % of the weight to it, there is an inclination for the problem the dirt of shaping metal mold, lowering of a mold-release characteristic and poor hardening of an epoxy resin molding compound, etc. to arise. The approach using an aluminum chelate compound as a curing catalyst of an epoxy resin is indicated by JP,57-133119,A and JP,57-133122,A. This approach is an approach for improving in both the preservation stability of an epoxy

resin molding compound, and reactivity. In this invention, a catalyst is separately blended as a hardening accelerator of an epoxy resin, and in order to make an aluminum chelate compound act as a coupling agent for improving the adhesive property during an insertion, it differs from the above-mentioned invention to which an aluminum chelate compound reacts with a direct epoxy resin.

[0014] In the epoxy resin molding compound of this invention, a bulking agent, a release agent, a coloring agent, a coupling agent, C and a \*\*\*\* agent, a flame retarder, etc. are added and used if needed besides the above-mentioned raw material. A bulking agent is the object which makes small the coefficient of thermal expansion of an epoxy molding material, and it is used in order to raise reinforcement, and it can use a minerals bulking agent at large [, such as talc, clay, a silica, a calcium carbonate, an aluminum hydroxide, a magnesium hydroxide, a glass fiber, and ceramic fiber, ]. 50 volume % - 85 volume % is suitable for a fill, and sufficient effectiveness is not acquired to reduction of a coefficient of thermal expansion, and improvement in reinforcement under by 50 volume %.

Moreover, if it blends exceeding 85 volume %, since the closest packing consistency of a bulking agent will be less than the loadings of an epoxy resin matrix, preparation of a molding material becomes difficult, and the viscosity after preparation becomes very high, and a moldability falls. Therefore, 50 volume % - 85 volume % of a fill is desirable. A release agent makes easy mold release from shaping metal mold, and uses carnauba wax, a montanoic acid system wax, and a polyolefine system wax independently, or uses together and uses these. 0.01 - 5% of the weight of the whole quantity of an addition is desirable. That is, it is because an adhesive property with a leadframe or a silicon chip will fall under by 0.01 % if there is no effectiveness in a mold-release characteristic and 5% is surpassed. As for a coloring agent, it is desirable to use carbon black. As being blended for toughening of a hardened material, and the reduction in an elastic modulus, with it being good, a \*\*\*\* agent etc. is used as an epoxy resin, the immiscible amino group or an epoxy group, the butadiene acrylonitrile system copolymer of a carboxyl group end and an end or the side-chain amino group, a hydroxyl group, an epoxy group, and a carboxyl group denaturation silicone resin system are good for a \*\*\*\* agent.

[0015] Blend and mix it, it is kneaded, the above-mentioned ingredient is ground, it corns if needed further, and an epoxy resin molding compound is obtained. Generally a hot calender roll, an extruder, etc. perform kneading. The plastic molded type semiconductor device of this invention is obtained by closing a semiconductor chip using the epoxy resin constituent obtained in this way. The manufacture approach is possible also by approaches, such as compression molding and casting, depending on the case, although low voltage transfer molding is usually used. Moreover, in order to improve the dependability of a semiconductor device, it is desirable after shaping by the epoxy resin constituent to perform a predetermined time after-cure at the temperature of 150 degrees C or more.

[0016] After blending and using the compound shown by \*\* 1 and \*\* 2 as mentioned above in this invention into an epoxy resin constituent, and also applying the compound shown by \*\* 1 and \*\* 2 to insertion independent, such as a semiconductor device and a leadframe, or some of those and processing the front face of an insertion, the semiconductor device excellent in dependability can be obtained also by closing using an epoxy resin constituent. Under the present circumstances, it is desirable to dissolve and use for a suitable organic solvent the compound shown by \*\* 1 and \*\* 2. It is suitable when various silane coupling agents raise an adhesive property especially as a solvent. When the insertion after applying these solutions performs heat treatment of several hours from several minutes at an elevated temperature, an adhesive property with an epoxy resin molding compound can be raised greatly.

[0017]

[Function] Excelling in this invention at a moldability and solder-proof reflow nature, moreover, the reason a plastic molded type semiconductor device with other good dependability is obtained is because the aluminum chelate coupling agent shown by \*\* 1 and \*\* 2 oozes out to an adhesion interface during hardening of an epoxy resin molding compound, the wettability of an epoxy resin and an insertion improves and an adhesive property also becomes large further. This is for an adhesive property to improve by the interaction of a surface of metal and an aluminum chelate, and for the adhesive property of the interaction of the interface of polyimide and an aluminum chelate of an epoxy resin molding compound and an insertion of polyimide etc. to improve substantially further, since it is large as

compared with a silane coupling agent etc.

[0018] Also when the plastic molded type semiconductor device package of this invention is exposed to a 240 degrees C - 260 degrees C elevated temperature at the time of mounting to a printed circuit board, since the adhesive strength between an epoxy resin molding compound and each insertion is large, the insertion interface in the package by rapid evaporation of the moisture inside a package does not produce exfoliation. Moreover, since exfoliation used as the haunt place of hygroscopic water etc. decreases, the crack of a package etc. is reduced and good solder-proof reflow nature is shown.

[0019]

[Example] Hereafter, this invention is concretely explained according to examples 1-11 and the examples 1-9 of a comparison.

[0020] As a fire-resistant assistant, montanoic acid ester was used as an epoxy silane and a release agent, carbon black was used for the epoxy resin list shown below as a coloring agent as an antimony trioxide and a coupling agent, using that to which triphenylphosphine was mixed as a phenol resin curing agent and a hardening accelerator, and three sevenths mixed globular form fused silica with a mean particle diameter of 28 micrometers with the crushing powder of fused silica with a mean particle diameter of 8 micrometers as a bulking agent, respectively, and the epoxy resin molding compound was produced by the combination presentation shown in a table 1. Kneading of a raw material was performed for 10 minutes using the hot calender roll (65 to 85 degree C) of two shafts.

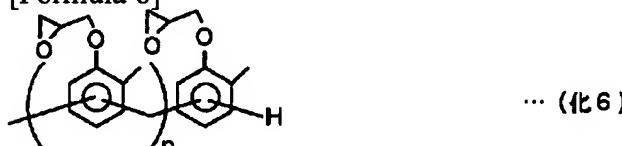
[0021] Epoxy-resin (a) weight per epoxy equivalent: 195 g/eq [0022]

[Formula 5]



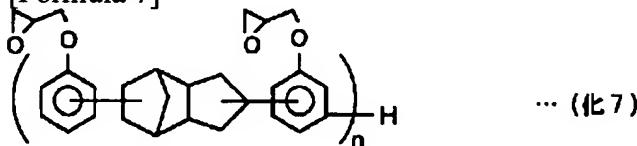
[0023] (b) Weight per epoxy equivalent : 195 g/eq [0024]

[Formula 6]



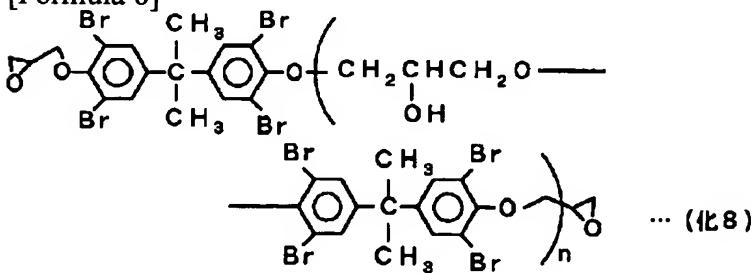
[0025] (c) Weight per epoxy equivalent : 257 g/eq [0026]

[Formula 7]



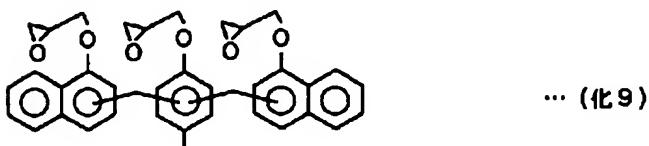
[0027] (d) Weight per epoxy equivalent : 221 g/eq [0028]

[Formula 8]



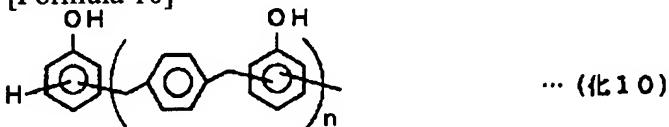
[0029] (e) Weight per epoxy equivalent : 375 g/eq [0030]

[Formula 9]



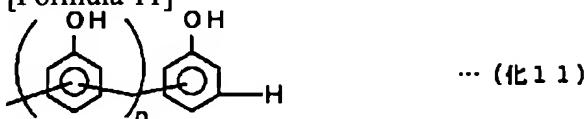
[0031] Phenol-resin curing-agent (f) hydroxyl equivalent: 171 g/eq [0032]

[Formula 10]



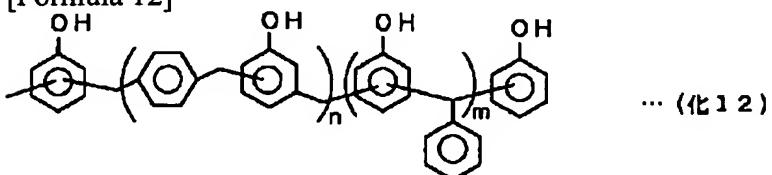
[0033] (g) Hydroxyl equivalent : 106 g/eq [0034]

[Formula 11]



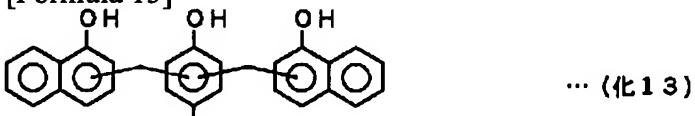
[0035] (h) Hydroxyl equivalent : 164 g/eq [0036]

[Formula 12]



[0037] (i) -- hydroxyl equivalent: -- 140 g/eq [0038]

[Formula 13]



[0039] Property measurement in a table was performed by the following approaches.

[0040] (1) Spiral flow : use the metal mold according to EMMI specification, and they are 180 degrees C and 70kg/cm<sup>2</sup>. It carried out on conditions.

[0041] (2) Glass transition temperature and coefficient of linear expansion : use a heat physical-test machine and they are the programming rate of 5 degrees C / min. It measured.

[0042] (3) Flexural strength and a bending elastic modulus : according to JIS-K6911, it measured at 250 degrees C in the room temperature list.

[0043] (4) Moisture absorption : fabricated the disc of diameter 90mmphi and thickness 2mm, and it was made to absorb moisture on the moisture absorption conditions of RH 85 degrees C / 85% for 300 hours, and asked from weight change.

[0044] (5) Aluminum adhesive strength : it asked for adhesive strength with aluminum foil with a thickness of 30 micrometers from the Peel reinforcement. The hauling rate of aluminum foil was measured by part for 50mm/.

[0045] (6) Polyimide adhesive strength : carried out the spin coat of the polyimide to aluminum foil with a thickness of 30 micrometers, it was made to harden on predetermined conditions, and the 10-micrometer polyimide film was formed on the aluminium tape. The epoxy resin molding compound was fabricated and torn off on the polyimide film, and the Peel reinforcement for 50mm/in rate was measured.

[0046] Next, the structure of the semiconductor device which applied this invention is explained using a

drawing.

[0047] After fixing the silicon chip 6 which is a semiconductor device to a leadframe 4 through the double-sided film-like adhesives 2 and drawing 1 connects electrically the polar zone and inner lead 4 on a component with the golden wire 1, it is the example of SOJ which closed the component and the inner lead with the epoxy resin constituent hardened material 3 (sealing agent).

[0048] After drawing 2 fixes the silicon chip 13 which is a semiconductor device by the layer indirect arrival material 11 in the die pad section 12 of a leadframe and connects electrically the polar zone and inner lead 10 on a component to it with the golden wire 9, it is the example of TSOP (Thin Small Outline Plastic Package) which closed the component and the inner lead with the epoxy resin constituent 8 (sealing agent).

[0049] Drawing 3 fixes the silicon chip 17 which is a semiconductor device using layer indirect arrival material on a multilayer printed circuit board. After connecting electrically the polar zone on a component, and the polar zone on a multilayer printed circuit board with the golden wire 16, The silicon chip on the silicon chip loading side of a multilayer printed circuit board 18 and the polar zone of a multilayer printed circuit board 18 are closed with the epoxy resin constituent 15 (sealing agent). It is the example of the BGA package (Ball Grid Package) which the solder ball 19 with which a silicon chip 17 and electric connection were taken on the background of the silicon chip loading side of a multilayer printed circuit board 18 has fixed.

[0050] Drawing 4 is the example of the semiconductor device closed with the epoxy resin constituent 20 (sealing agent), after connecting electrically the silicon chip 21 which is a semiconductor device, and the solder ball 23 by the double-sided glue line 22 which has elasticity.

[0051] As compared with the epoxy resin constituent shown in the examples 1-9 of a comparison, the adhesive property of the epoxy resin constituent [ for semi-conductor closure ] in this invention to aluminum and polyimide is improving so that clearly from a table 1.

[0052]

[A table 1]

表 1

用いた素材	番号	実験例										比較例									
		1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9
エポキシ樹脂	(a)	85	85	85	85	85	85	85	85	85	85	85	—	—	—	—	85	85	—	—	—
	(b)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	85	85	—	—	—
	(c)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	85	—	—	—
	(d)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	85	—	—	—
	(e)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	(f)	54	54	54	—	—	—	—	—	—	—	—	—	—	—	—	—	81	—	83	—
フェノール樹脂硬化剤	(g)	—	—	—	50	—	—	—	—	—	—	—	—	—	—	—	—	50	—	—	—
	(h)	—	—	—	—	78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(i)	—	—	—	—	—	67	—	—	—	—	—	—	—	—	—	—	67	—	—	—
	極化度測定 TPP	2	2	2	2	2	1.8	2.2	2	1.8	1.8	2	2	2	2	2	1.8	2.2	2	1.8	2
	充電率(74容量%)	10877	10889	10822	917	1072	1010	1090	917	988	1043	973	1086	915	1070	1068	1088	915	886	1041	976
	三酸化アンチモン	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
シランカップリング剤	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	化2※	0.2	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	離型剤	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	着色剤	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	成形性 ブライルフ (Inch)	35	38	42	37	38	34	32	28	38	32	38	32	36	36	36	34	32	28	37	32
	ガラス転移温度 (℃)	135	133	132	145	142	156	150	155	145	156	136	146	143	157	152	157	146	148	158	
線膨張係数 (ppm/K)	1.1	1.1	1.1	1.1	1.1	1.1	1	1.1	1	1.1	1	1.1	1.1	1	1.1	1	1.1	1	1.1	1.1	
	曲げ強度 (kg/mm²)	15.0	14.8	14.6	17.0	16.0	16.0	14.5	13.1	13.5	15.0	14.5	15.1	17.2	17.0	16.3	14.7	12.3	13.5	15.3	14.6
	250°C	2.08	1.90	1.82	2.63	2.44	2.50	1.80	2.10	1.90	1.70	1.33	1.69	2.52	2.45	2.52	1.85	2.25	1.92	1.65	1.42
	曲げ弹性率 (kg/mm²)	2135	2132	2100	2234	2342	2350	2300	2560	2490	2350	2297	2160	2310	2250	2400	2331	2510	2330	2360	2310
	250°C	129	128	125	129	123	120	130	130	120	85	100	67	132	135	115	165	142	155	82	120
	吸湿率 (重量%)	0.275	0.273	0.273	0.281	0.281	0.221	0.213	0.313	0.234	0.23	0.24	0.271	0.285	0.28	0.227	0.216	0.32	0.237	0.233	0.242
アルミニビール密度 (g/cm³)	920	980	900	630	784	520	580	470	820	600	580	650	510	620	480	500	460	750	450	500	
	ボリミドビール密度 (g/cm³)	750	800	750	750	720	820	750	820	750	820	750	820	650	650	700	620	550	620	500	560

※) 化2：アルミニウムトリス（エチルアセトアセテート）

[0053] If it compares for every resin system like examples 1-3, the example 1 of a comparison and an example 4, the example 2 of a comparison and an example 5, the example 3 of a comparison and an example 6, the example 4 of a comparison and an example 7, the example 5 of a comparison and an example 8, the example 6 of a comparison and an example 9, the example 7 of a comparison and an example 10, the example 8 of a comparison and an example 11, and the example 9 of a comparison Since aluminum PIRU reinforcement and PIQ Peel reinforcement become large, without spoiling physical properties, such as glass transition temperature, flexural strength, a bending elastic modulus, and moisture absorption, improvement in dependability, such as increase of the adhesive strength of the

insertion inside a semiconductor device and a sealing agent, solder-proof reflow nature, and temperature cycle nature, is expectable.

[0054] Moreover, TSOP shown in SOJ shown in drawing 1 and drawing 2 was produced using this ingredient. The reliability trial of solder-proof reflow nature performed the trial which heats this plastic molded type semiconductor device for 90 seconds all over a 240-degree C infrared reflow furnace promptly after 168-hour neglect under 85 degrees C and 85%RH, and investigated that in which the closure layer carried out the crack as crack occurrences. Moreover, the exfoliation situation of a closure resin layer and each insertion in a semiconductor device was investigated using ultrasonic test equipment, and what exfoliated was counted as exfoliation occurrences. These results are collectively shown in a table 2.

[0055]

[A table 2]

## 表 2

パッケージ形状	不良モード	実施例											比較例							
		1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8
SOP	クラック数	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	封止材/シリコン耐引張強度	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	封止材/ポリイミド耐引張強度	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
TSSOP	クラック数	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	封止材/シリコン耐引張強度	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
	封止材/ポリイミド耐引張強度	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10

主) 各種の接着剤、不良部、不良箇所を示した。  
比較例：85°C/85%RH/168時間強制試験、240°C/90秒の元カセットフロー

[0056] Since the resin seal semiconductor device of this invention is a high adhesive property, it turns out that the number of exfoliations with the insertion of a leadframe, a chip, etc. decreases, so that clearly from a table 2. Moreover, it turns out that the crack of the closure layer itself is also controlled and the outstanding solder-proof reflow nature is shown by this. Moreover, to the insertion, although it was a high adhesive property, it turned out that the mold-release characteristic at the time of package shaping is excellent.

[0057]

[Effect of the Invention] Since the adhesive property between each insertion in a package and a sealing

agent is large compared with the conventional thing, the plastic molded type semiconductor device obtained by this invention is excellent in solder-proof reflow nature, and can show good properties, such as temperature cycle nature and an elevated-temperature neglect property.

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[Translation done.]

## \* NOTICES \*

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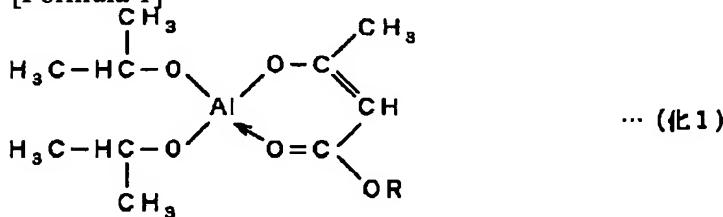
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## CLAIMS

## [Claim(s)]

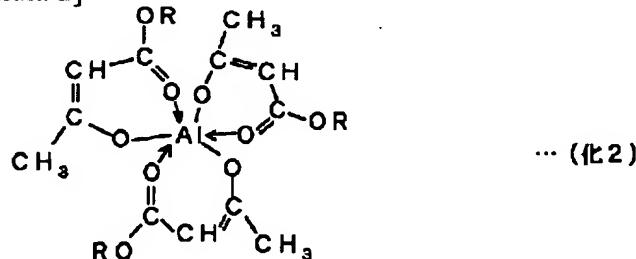
[Claim 1] The semiconductor device characterized by closing with the epoxy resin constituent containing an epoxy resin, and the curing agent and hardening accelerator which have a phenolic hydroxyl group, and the aluminum chelating agent further expressed with \*\* 1 and \*\* 2.

## [Formula 1]



R : CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, <sup>1</sup>C<sub>3</sub>H<sub>7</sub>, C<sub>4</sub>H<sub>9</sub>

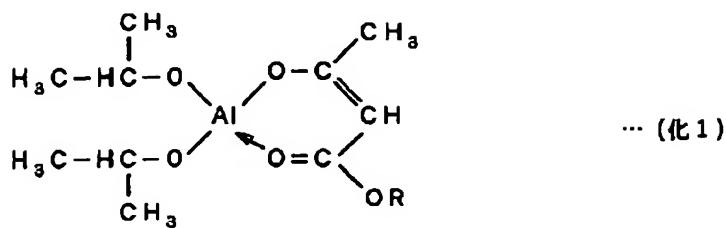
## [Formula 2]



R : CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, <sup>1</sup>C<sub>3</sub>H<sub>7</sub>, C<sub>4</sub>H<sub>9</sub>

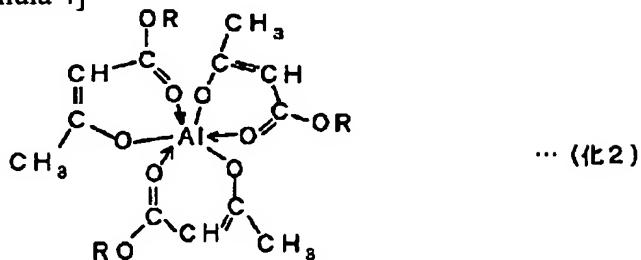
[Claim 2] The semiconductor device which surface treatment is carried out with the silicone coupling agent solution which contains the aluminum chelating agent expressed with \*\* 3 and \*\* 4 in a part of semiconductor device by which between said inner leads was electrically connected with the electrode on the front face of a semiconductor device which fixed to the inner lead of a leadframe, and said leadframe as an indispensable component, and is characterized by closing with the epoxy resin constituent containing the curing agent which has an epoxy resin and a phenolic hydroxyl group for a part of said semiconductor device and said leadframe, and a hardening accelerator.

## [Formula 3]



R ; CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>3</sub>H<sub>7</sub>, C<sub>4</sub>H<sub>9</sub>

[Formula 4]



R ; CH<sub>3</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>3</sub>H<sub>7</sub>, C<sub>4</sub>H<sub>9</sub>

[Claim 3] The plastic molded type semiconductor device closed with the epoxy resin constituent which the bulking agent which consists of a minerals particle 50-85 capacity % Contains to all constituents in claims 1 or 2.

[Translation done.]